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Research Article

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Development of optimum land use plan and carrying capacity assessment through land characterization and soil site suitability evaluation in Pratapgarh district of Rajasthan

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Summary

A soil survey study deploying soil resource mapping unit was conducted during 2011 in Pratapgarh district of Rajasthan to evaluate land characteristics and soil site suitability for major field and fruit crops as well as to develop optimum land use plan. Soils of eight pedons adequately representing the district belonged to *Entisols, Inceptisols* and *Vertisols* orders and widely varied in slope (<1 to 30%), texture (sandy loam to clay), soil depth (30-80 cm), available soil water (0.13 to 0.22 $M^3 M^{-3}$), $CaCO_3$ content (0 to 126.21 g kg^{-1}), pH (6.04 to 7.55), organic carbon (0.24 to 0.79%), cation exchange capacity (12.90 to 36.81 Cmol, p+, kg^{-1}) and exchangeable sodium percentage (1.69 to 4.58%). However, chemical and physical properties were largely affected by position of land form and regional geology. In general, deep, fine textured and dark coloured soils of plain landform constituted higher suitability class for different field crops followed by valley soils (relatively less developed than plain landform) that were of intermediate value in physical and chemical properties (coarser textured, lower water and nutrient holding capacity, high calcium carbonate), weathering and suitability for crops. Grain and dry fodder productivity of different field crops was maximum at plain landform followed by valley, hill slope and hills except wheat and chickpea had higher productivity on valley soils. Among different crop suitability classes (highly suitable, suitable, moderately suitable, marginally suitable and not suitable); highly suitable crops on soils of different pedons comprised of maize, wheat and chickpea on P_3; rice, maize and chickpea on P_4; soybean on P_7 and rice, maize, green gram, soybean and chickpea on P_8. Among different crops, maize was suitable on soils of all pedons except P_7 while wheat was found suitable on five pedons (P_2, P_3, P_4, P_7 and P_8); chickpea and mustard on four pedons (P_3, P_4, P_7 and P_8); garlic and isabgol on three pedons (P_4, P_7 and P_8); mango on all pedons except P_8; aonla on all pedons except P_7 and P_8 and guava on six pedon (P_1, P_2, P_4, P_5 and P_8). Carrying capacity of Pratapgarh soils estimated in terms of total production of cereals, pulses, oil seed and dry and green fodder indicated a surplus 55836.2, 11584.35, 133966.1, 5529284 and 3491432 tons in 2011 and 20369.5, 7748.92, 130707.19, 5114305 and 1968001 tons in 2020, respectively.

Key words : Optimum land, Carrying capacity, Soil site suitability evaluation

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Introduction

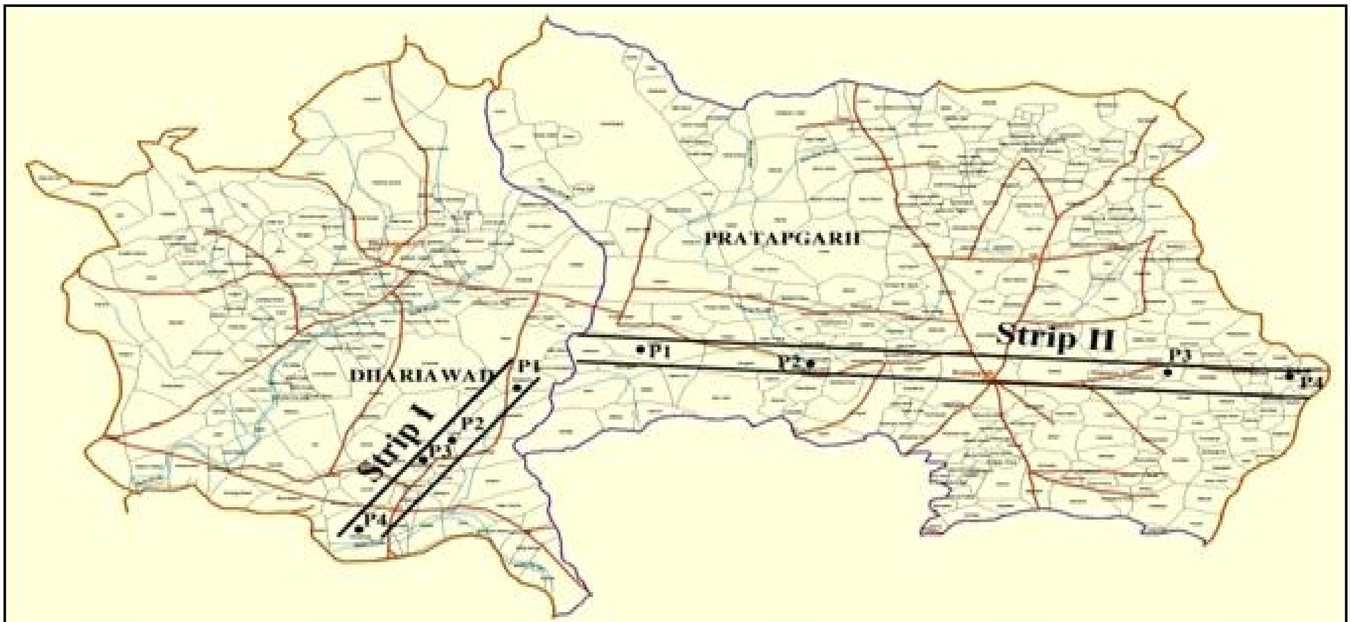
Land suitability evaluation (ranking of soil units according to their inherent capabilities under a given environment that also includes level of management and socio-economic conditions) for field crops is a prerequisite for land use planning. It indents to provide the highest return per unit of land area and emphasizes on conservation of natural resources for future use (Sys *et al.*, 1991). Performance of crops is greatly influenced by soil site parameters, climate, topography and management level (Sehgal, 1991). Therefore, it is essential to interpret the soil site suitability for major crops in an area with focus on species specific edaphic and climatic requirement for their optimal growth and productivity. Production oriented crop cultivation on appropriate soils (taxonomic unit) is more beneficial (Bhaskar *et al.*, 2004). In backdrop of little or no information on soil site suitability for different crops in Pratapgarh district of Rajasthan, present study was conducted for land characterization and assessment of soil site suitability for major crops (upland rice, maize, soybean, green chickpea, wheat, mustard, chickpea, isabgol, garlic and mango) on major soil orders (*Entisols*, *Inceptisols* and *Vertisols*) in Aravali hills and Malwa plateau.

Resource and Research Methods

Study area :

Pratapgarh, a tribal district situated at junction of Aravali hills and the Malwa Plateau in the southern Rajasthan at 29.03^{o} north and 74.78^{o} east, has a total area of 411736 ha adjoined by districts of Udaipur and Bhilwara (Rajasthan) and Mandsaur (Madhya Pradesh), Pratapgarh comes in Udaipur division. Pratapgarh has five sub-divisions (Arnod, Chotisadri, Dhariyawad, Peepalkhoont and Pratapgarh) with an average elevation of 491 meter above mean sea level (the highest elevation in Rajasthan after Mount Abu) (Fig. A).

A soil survey study deploying soil resource mapping units (SRM) was conducted during 2011 in Aravali hill



Strip I		Strip II	
Aravali hills	SRM Unit	Malwa plateau	SRM unit
P_1Dipora	172	P_5Chiklad	318
P_2 Lodiya	193	P_6 Shah jikapathar	330
P_3 Bhagadera	239	P_7 Ghotarsi	324
P_4 Charpotiya	229	P_8 Kuni	337

Fig. A : Site details of profile examination and sampling in Aravali hills and Malwa plateau

range and Malwa plateau to evaluate morphological characteristics of eight pedons (hill top: P_1 and P_5; hill slope: P_2 and P_6; valley: P_3 and P_7 and plain: P_4 and P_8) on different land forms following procedure detailed in Soil Survey Manual, IARI (1970). Horizon-wise soil samples collected from typifying pedons at various landforms were analyzed for physical, physico-chemical and chemical properties and classified according to soil taxonomy (FAO, 1976; Soil Survey Staff, 1998 and 2000). Suitability of pedons was assessed deploying the limitation method that comprised of number and intensity of limitations as suggested by Sys *et al*. (1991). Soil site suitability evaluation for different crops and fruit trees involved working out the weighted mean of parameters by collecting data on landscape, soil characteristics and climatic parameters (rain fall, drainage, per cent slope, soil texture, soil depth, available water content, $CaCO_3$ content, pH, per cent soil organic carbon, cation exchange capacity or CEC and exchangeable sodium percentage or ESP) according to procedure furnished by Sys *et al*. (1991). After working out soil site suitability, the extent of suitability of crops were accordingly assessed and indicated in the optimum land use plan. Total production of cereals, pulses, oilseeds and dry and green fodder was estimated by multiplying the estimated productivity of grain and fodder of different field crops at different landforms in both transects with their respective acreage. Total annual food requirement of district was estimated by multiplying daily per capita food requirement as fixed for different age groups of human beings by Indian Council of Medical Research (ICMR) and their respective population and 365. Similarly, total annual fodder requirement was assessed by multiplying daily per capita fodder requirement of different age group of various animals as recommended by Food and Agricultural Organization (FAO); their respective population and 365. Carrying capacity estimation involved dividing total production of cereals, pulses, oilseeds etc and fodder with daily per capita standard food and fodder/ feed requirement of different age group of existing human and animal population, respectively. Projected food and fodder requirement of district for year 2020 was estimated by assessing the expected human and animal population in 2020 on the basis of growth rate for the year 2011 and by multiplying the so assessed population with 365 and daily dietary and fodder needs again in accordance with recommendations furnished for human beings by ICMR and for animals by FAO.

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Soil site suitability evaluation :

Data pertaining to rainfall, drainage, slope and various physical and chemical soil properties (Table 1) revealed

Table 1: Soil site suitability evaluation (weighted mean of parameters) in Aravali hills and Malwa plateau parts of Pratapgarh district of Rajasthan

Pedons	Rainfall (mm)	Drainage	Slope (%)	Texture	Soil depth (cm)	AWC (M^3/M^3)	$CaCO_3$ (g kg^{-1})	pH	OC (%)	CEC Cmol (p+) kg^{-1}	ESP
Aravali hill range											
P_1	856	Moderately excessive	8-15	Sl	30	0.22	0.00	7.33	0.79	12.90	4.26
P_2	856	Moderately excessive	8-15	L	50	0.13	0.00	7.41	0.43	21.02	2.39
P_3	856	Moderately excessive	3-8	Sl	75	0.21	0.00	7.46	0.27	19.24	3.10
P_4	856	Well drained	<1	Sic	70	0.22	86.14	7.55	0.24	36.60	2.08
Malwa plateau											
P_5	856	Moderately excessive	15-30	Scl	40	0.13	0.00	6.04	0.52	18.22	4.58
P_6	856	Moderately excessive	8-15	Scl	50	0.13	0.00	7.13	0.51	26.59	4.31
P_7	856	Well drained	3-8	Scl	80	0.18	126.21	7.14	0.55	22.65	2.05
P_8	856	Well drained	<1	C	80	0.22	92.04	7.38	0.43	36.81	1.69

that study area had an average rainfall of 856 mm but drainage was relatively excessive in hill top, hill slope and valley parts while plain areas were well drained in both transects (Aravali hills and Malwa plateau). This can be ascribed to higher slope and undulating topography in hill, hill slope and valley landforms (3-30%) than plain topo feature (<1%). The highest slope of 15-30 per cent was recorded at hill top pedon (P_5) of Malwa plateau. A moderating trend in degree of slope was noted on movement from hill to plain landform in both transects. Depending upon texture which ranged from sandy loam to clay, the available soil water holding capacity varied from 0.13 to 0.22 m^3/m^3 with weighted mean of 0.195 m^3/m^3 in the Aravali hill range. Maximum available soil water holding capacity was recorded in plain (P_4) and hill top (P_1) followed by valley (P_3) pedon and hill slope (P_2) pediments in Aravali hills. In Malwa plateau, available soil water holding capacity also ranged from 0.13 to 0.22 m^3/m^3 but weighted mean was 0.165 m^3/m^3 with trend that available soil water holding capacity was maximum in plain (P_8) followed by valley (P_7) while hill top and hill slope (P_5 and P_6) had lowest but identical value. This indicated that Aravali hill soils were on an average better than soils of Malwa plateau in available soil moisture holding potential. Soil depth ranged from 30 to 75 cm (weighted mean 56.25 cm) in Aravali range while it ranged between 40 and 80 cm (weighted mean 62.5 cm) in Malwa plateau indicating that latter soils were on an average better than former in soil depth. Soil depth was the highest in P_7 and P_8 pedons of Malwa plateau while it was lowest 'in P_1 pedon of Aravali range.

Calcium carbonate content in soils of Aravali hills ranged from 0.00 to 86.14 g kg^{-1} with weighted mean of 21.03 g kg^{-1} while in Malwa plateau its ranged from 0.00 to 126.21 g kg^{1} (weighted mean 56.56 g kg^{-1}). It is not able that calcium carbonate was present in only three pedons with trend that $P_7 > P_8 > P_4$. Soil reaction (pH), a key parameter controlling soil nutrient availability to plants, varied from 7.33 to 7.55 with mean value of 7.44 in soils of Aravali hills while pH of Malwa plateau soils ranged from 6.04 to 7.38 with mean value of 6.92. Among different pedons, soils of pedon P_5 of Malwa plateau only recorded the acidic pH while maximum pH was recorded in the soils of P_4 pedon in Aravali hills. The soil organic carbon content, an indicator of nitrogen status, ranged between 0.24 and 0.79 per cent with weighted

Table 2: Estimated productivity of grain (q ha^{-1}) of different field crops on different landforms of Aravali hills and Malwa plateau in Pratapgarh district of Rajasthan

Crops	Hill top	Hill slope	Valley	Plain
Aravali hill range				
Rice	3	10	10.5	18.62
Maize	13.65	13.82	22.25	22.67
Green gram	1.25	1.57	4.25	5.87
Soybean	7.13	8.12	9.15	10.25
Wheat	10.12	18.25	29.11	28.78
Mustard	5.01	6.12	12.05	12.10
Chickpea	4.41	5.35	10.23	9.11
Isabgol	3.21	4.12	5.75	6.34
Garlic	15.11	18.09	27.21	29.10
Malwa plateau				
Rice	8.85	9.12	16.65	18.25
Maize	18.05	18.12	18.25	22.65
Green gram	1.15	1.87	4.12	5.70
Soybean	5.21	6.22	14.55	14.67
Wheat	10.10	27.85	28.12	29.79
Mustard	5.12	6.12	12.05	12.15
Chickpea	5.75	6.02	9.24	10.34
Isabgol	2.51	3.85	5.95	6.09
Garlic	16.05	19.12	28.85	29.05

mean of 0.43 in Aravali hills while in Malwa plateau soils it ranged between 0.43 and 0.55 per cent with weighted mean of 0.50 per cent. Maximum soil organic carbon content was recorded at hill top pedon P_1 which can be ascribed to flatness and slight depression of this landform at pedon site in Aravali hills. CEC of soils of different pedons in Aravali hills varied from 12.90 to 36.60 C mol (p^+) kg^{-1} [weighted mean 22.44 C mol (p^+) kg^{-1}] while in Malwa plateau soils CEC ranged from 18.22 to 36.8 C mol (p^+) kg^{-1} [weighted mean 26.06C mol (p^+) kg^{-1}]. Maximum CEC was recorded in plain pedons ($P_4 > P_8$) which revealed the cause behind their highest production potential among different landforms under study. Results thus conclude that although soils of Aravali hills have higher weighted mean values of available soil moisture and pH but they have lower weighted mean values of CEC, calcium carbonate content and organic carbon than Malwa plateau soils.

Data revealed that productivity of different crops which represents the comprehensive sum product of interaction of all and different production factors, on same as well as different landforms within and between both transects recorded considerable and wide variations (Table 3 and 4). This also constituted a part of basis for

Table 3: Estimated productivity of fodder (q ha^{-1}) from different field crops on different landforms of Aravali hills and Malwa plateau in Pratapgarh district of Rajasthan

Crops	Hill top	Hill slope	Valley	Plain
Aravali hill range				
Rice	7	18	19.50	38.52
Maize	26.84	27.02	44.83	45.02
Green gram	2.85	3.25	10.30	12.90
Soybean	15.21	17.55	20.21	21.25
Wheat	23.25	32.20	45.02	43.75
Mustard	11.23	13.05	24.89	25.02
Chickpea	5.43	7.21	12.20	11.18
Malwa plateau				
Rice	16.82	19.05	31.05	38.52
Maize	37.21	37.05	36.44	45.01
Green gram	2.65	3.02	9.10	12.05
Soybean	11.18	13.07	28.22	28.35
Wheat	21.11	42.08	43.85	44.20
Mustard	11.10	13.02	24.75	25.15
Chickpea	6.85	7.15	11.05	12.22

Table 4: Overall soil site suitability for different field crops and fruit trees on soils of different landforms of Aravali hill range and Malwa plateau in Pratapgarh district of Rajasthan

Pedons	Soil site suitability		
	Kharif crops	*Rabi* crops	Fruit trees
Aravali hill range			
P_1	Rice (N), maize (S_3), green gram (N), soybean (N)	Wheat (N), mustard (N), chickpea (N), garlic (N), isabgol (N)	Mango (N),
P_2	Rice (S_2), maize (S_2), green gram (N), soybean (N)	Wheat (S_2), mustard (N), chickpea (N), garlic (N), isabgol (N)	Mango (N)
P_3	Rice (S_2), maize (S_1), green gram (S_2), soybean (N_1)	Wheat (S_1), mustard (S_2), chickpea (S_1), garlic (S_3), isabgol (S_3)	Mango (S_3)
P_4	Rice (S_1), maize (S_1), green gram (S_1), soybean (N_1)	Wheat (S_2), mustard (S_2), chickpea (S_2), garlic (S_2), isabgol(S_2)	Mango (S_3)
Malwa plateau			
P_5	Rice (N), maize (S_2), green gram (N), soybean (N)	Wheat (N), mustard (N), chickpea (N), garlic (N), isabgol (N)	Mango (N)
P_6	Rice (N), maize (S_2), green gram (N), soybean (N)	Wheat (S_2), mustard (N), chickpea (N), garlic (N), isabgol (N)	Mango (N)
P_7	Rice (S_2), maize (S_2), green gram (S_2), soybean (S_1)	Wheat (S_2), mustard (S_2), chickpea (S_2), garlic (S_2), isabgol(S_2)	Mango (S_3)
P_8	Rice (S_1), Maize (S_1), Green gram (S_1), Soybean (S_1)	Wheat (S_1), mustard (S_2), chickpea (S_1), garlic (S_2), isabgol (S_2)	Mango (N)

Order 'S' suitable, S_1: Highly suitable, S_2: Moderately suitable, S_3: Marginally suitable, N-Not suitable

decision on suitability of crops. The variations in productivity (q ha^{-1}) of different crops at different land forms in both transects ranged as 3 to 18.62 in rice, 13.65 to 22.67 in maize, 1.15 to 5.87 in green gram, 5.21 to 14.67 in soybean, 10.10 to 29.79 in wheat, 4.41 to 10.34 in chickpea, 2.51 to 6.34 in isabgol and 15.11 to 29.10 in garlic, which is wide enough. Variations in productivity of crops on same landform in both transects can be ascribed to relative site suitability for different crops but level of production was more important in development of optimum land use plan besides land potential based on characteristics. Considering hill landform only, higher productivity of green gram, soybean, wheat and isabgol was recorded on Aravali hill soils while rice, maize, mustard, chickpea and garlic recorded higher productivity on Malwa plateau soils (Table 3). Similarly at hill slope landform, higher productivity of rice, soybean and isabgol was recorded on Aravali hill soils while higher productivity of maize, green gram, wheat, chickpea and garlic was recorded on Malwa plateau soils. Within valley landform, maize, green gram, wheat and chickpea recorded higher productivity on Aravali hill soils but rice, soybean, isabgol and garlic recorded higher productivity on Malwa plateau soils. Within plain landform only, higher productivity of rice, maize, green gram, isabgol and garlic was recorded on Aravali hill soils while higher productivity of soybean, wheat, mustard and chickpea was recorded on Malwa plateau soils. In fact, potential difference in productivity (high, medium and low) of different field crops on same landform in both transects constituted the basis for optimum land use plan for different field crops in study area.

Overall soil site suitability in Aravali hills :

Soils of hill top pedon in Aravali hills (P_1) were normally not suitable for different field crops and mango except they were marginally suitable for maize (Table 4). This can be ascribed to excessive land slope, poor soil fertility and shallow soil depth which rendered them unfit for sustainable agricultural use. Therefore, these soils may be kept under natural vegetation or developed as forest or grass lands after treating with suitable soil and water conservation measures like contour and stone bunds in order to prevent their further degradation. Soils of pedon P_2 were again not suitable for majority of crops and mango plantation on account of poor water holding capacity, steep slope and excessive drainage; however, in scattered patches they were marginally suitable for rice, maize and wheat. Soils of valley pedon P_3 were highly suitable for maize, wheat and chickpea; moderately suitable for rice, green gram and mustard and marginally suitable for garlic, isabgol and mango plantation. Soils of pedon P_4 were highly suitable for cultivation of upland rice, rain-fed maize and green gram; moderately suitable for wheat, mustard, chickpea, garlic and isabgol but marginally suitable for mango plantation.

Overall soil site suitability in Malwa plateau :

Hill top soils (P_5) were normally not suitable for majority of crops and mango except they were moderately suitable for maize. Pediment P_6 was moderately suitable for maize and wheat. The pedons P_5 and P_6 were not suitable for arable and plantation crops on account of their inherent limitations (excessive slope, severe erosion, shallow depth and absence of irrigation facilities) that make them unfit for sustained agricultural use. These soils may be kept under natural vegetation after treatment with appropriate soil conservation measures in order to prevent their further degradation or they can be developed as forest or as grasslands. Soils of pedon P_7 were highly suitable for soybean; moderately suitable for upland rice, maize, green gram, wheat, mustard chickpea, garlic and isabgol and marginally suitable for mango plantation. These soils require treatment with proper soil and water conservation measures to combat high erosion rates and to enhance available soil moisture through *in situ* conservation of rain water. Plain soils of pedon P_8 were highly suitable for upland rice, maize, green gram, soybean, wheat and chickpea; moderately suitable for mustard, garlic and isabgol but not suitable for mango plantation.

Optimization of land use :

Productivity on soils of different landforms of Aravali hills and Malwa plateau (Table 2 and 3) provided a basis for optimization of land use (Table 5) since it adequately revealed that what field and fruit crops can be cultivated in a large scale and what crops and fruit plants can be grown on a limited scale (with and without *in situ* soil and rain water conservation or some other specific package of practice) or cannot be grown at all, on soils of a particular landform. Land capability, farmer's needs and preferences, marketing potential, needs for *in situ* conservation of soil and rain water etc were also taken into account for development of optimum land use plan. Among different land forms, plain soils (P_4 and P_8) constituted the best crop suitability class on account of

fact that they have less than 1 per cent slope (minimum erosion and more *in situ* conservation of soil and rain water), well drained, had virtually the highest water holding capacity (22%) due to silty clay to clay texture, good soil depth (70-80 cm) and notably the highest CEC (36.60 to 36.81 Cmol, p+, kg^{-1}) which in practice is key to govern the nutrient availability and fertilizer response. Higher suitability of crops at soils of valley and plain landforms in both transects can be attributed due to lower slope (<1 to 8%), more soil depth (70-80 cm), higher water holding capacity (0.18-0.22 M^3/ M^3) and higher CEC (19.24-36.81 Cmol, p+, kg^{-1}).

Other than field crops; fruit plantation (mango, guava and aonla) was also carried out on soils of hill top (P_1 and P_5) and hill slope (P_2 and P_6) in both Aravali hills and Malwa plateau, respectively. Although poor soil fertility, shallow soil depth, excessive slope and severe erosion constituted an environment that was not congenial for fruit plantation, yet fruit plantation can be made successful by digging ditches of adequate size and filling them with good soil and manure mixture. After proper establishment, trees need to be regularly watered and cared properly for protection from grazing animals. Grasses can be planted in and around pedons in valley and hill top landforms to check the onslaught of soil erosion. After keeping area protected for some years, the landscape may be in a position to produce fodder and fruits trees and major constraints *i.e.* high soil erosion rate may be brought under permissible limits and to enable the soil formation to take place.

To meet out dietary need and satisfy food habit of people in Pratapgarh district, cultivation of *Kharif* (maize, soybean and chickpea) and *Rabi* (wheat and mustard, sole chickpea and chickpea + wheat/ mustard) crops are recommended on soils of valley pedons P_3 and P_7. Alternate land uses at elevated valley areas of P_3 and P_7 pedons can comprise of cultivation of maize and soybean during *Kharif* in agro-forestry association

Table 5: Optimum land use plan for soils of Aravali hill range and Malwa plateau on different landforms in Pratapgarh district of Rajasthan

Pedons	Soil site suitability		
	Kharif crops	*Rabi* crops	Fruit trees
Aravali hill range			
P_1^*	Maize	-	Silvi-pasture and horticulture (mango, guava and aonla)
P_2^*	Rain-fed upland rice, maize, wheat		Silvi-pasture and horticulture (mango, guava and aonla)
P_3	Maize, cowpea/ black gram/ green gram	Mustard, wheat, chickpea	Mango, aonla
P_4	Rice▲, maize, green gram, sugar cane▲	Wheat, mustard, chickpea, garlic, isabgol	Mango, guava, aonla
Malwa plateau			
P_5^*	Maize	-	Silvi-pasture and horticulture (mango, guava and aonla)
P_6^*	Maize	-	Silvi-pasture and horticulture (mango, guava and aonla)
P_7	Soybean, rice, green gram	Wheat, mustard, chickpea, garlic, isabgol	Mango,
P_8	Rice, maize, green gram, soybean	Wheat, chickpea, mustard garlic, isabgol	Guava,

*Partially suitable or not suitable, however, horticultural plantations can be undertaken after digging the pits, adequate manuring and watering, plantation of trees on the ridges and other recommended package of practices for the region.
▲Can be raised with irrigation.

Table 6: Human food requirement for Pratapgarh district

Food item	Requirement in 2011 (Tons)			Requirement in 2020 (Tons)			Available (Tons)	Shortage/ surplus (Tons)	
	Male	Female	Total	Male	Female	Total	2011	2011	2020
Cereals	78325.35	76952.95	155278.8	95546.05	95199.03	190745.35	211115	+558362.2	+20369.65
Pulses	8471.65	8322.00	16793.65	10333.15	10293.65	20629.08	28378	+11584.35	+7748.92
Oil	7190.5	7066.04	14256.9	8774.06	8741.75	17515.81	148223	+133966.1	+130707.19

Table 7: Animal fodder requirement for Pratapgarh district

Fodder	Requirement 2011 (Tons)			Requirement 2020 (Tons)			Available (Tons)	Shortage (Tons)	
	Cow	Buffalo	Total	Cow	Buffalo	Total	2011	2011	2020
Dry fodder	2817192	1913292	4730484	6338682	4304907	10643589	5529284	+798800	5114305
Green fodder	1209095	1085642	2294737	3327285	2132148	5459433	3491432	+1196695	1968001

following proper geometry and tree-crop compatibility. Maize-chickpea system can also be practiced in the tree interspaces to partially meet out pulse demand. Trees in agro-forestry at a stage will start providing fodder, fruits and timber. The plain soils (P_4) of Aravali hills can be utilized for cultivation of upland rice, maize, green chickpea and soybean during *Kharif* while wheat and mustard and/or chickpea can be grown during *Rabi* season. *Kharif* (maize, and soybean or cowpea) and *Rabi* (mustard and wheat, isabgol and lentil) crops can be grown on plain soils (P_8) of Malwa plateau. Plain soils (P_4 and P_8) in both transects can be utilized for mango, guava and aonla plantation with adequate measures to combat the existing soil salinity; addition of organic manures and land management practices intended on *in situ* soil and rain water conservation.

Carrying capacity :

Data (Table 6 and 7) revealed that requirement of cereals; pulses and oilseeds were 155278.8, 16798.65 and 14256.9 tons during 2011 with corresponding availability of 211115, 28378 and 148223 tons, respectively. Daily per capita availability of cereals and pulses were 666 and 80 g which were 176 and 25 g higher than standards fixed by ICMR *i.e.* 490 and 53 g, respectively. This revealed that at present production level of food grains and oilseeds, Pratapgarh district possess carrying capacity or potential to accommodate additional human population in backdrop of fact that there exists a surplus of 55836.2, 11579.35 and 133966.1 tons of cereals, pulses and oilseeds, respectively which can be sold by farmers. Similarly, animal fodder was also in abundance during 2011 to a tune of 798800 and 1196695 tons, respectively. It is obvious that at growth rate of 2011, there exists a projected surplus of cereals, pulses, oilseeds and dry and green fodder to an extent of 2039.65, 7748.92, 130707.19 and 5114305 and 1968001 tons in 2020, respectively. However, suggested land use plan is required for sustainability of agricultural production systems in future since it utilizes the principle of "use of land according to its potential" that is not only important from point of view of long term maintenance of soil fertility but also takes in to account the *in situ* conservation of soil and rain water, protection of natural flora and fauna on non arable lands, crop diversification and other many tangible and non tangible benefits for prosperity and posterity of people in the area.

Canclusion :

Results of study revealed that development of optimum land use plan on basis of resource conservation principle "Use of land according to its potential" deploying suitable *in situ* rain water and soil conservation measures on undulating and plain terrains of Pratapgarh district holds key in not only sustaining the productivity of different field and horticultural crops at different landforms on long term basis but it stands crucial in mitigating the current land degradation occurring mainly on account of water erosion. Land not suitable for crops can be brought under grass land, silvi-pasture and horticulture (mango, guava and aonla) in proportions suiting to market and domestic aspirations of local people in the district.However, for successful horticulture, digging of pits, adequate manuring and watering and follow up of other recommended package of practices for region which requires a transfer of technology campaign, is essential. Pratapgarh district has been found to be self reliant in food grains, oilseeds and dry and green fodder during 2011 and 2020 but optimum land use plan is needed for sustaining future production by maintenance of soil fertility, crop diversification, *in situ* conservation of soil and rain water, protection of flora and fauna particularly on non- arable lands and other several tangible and non-tangible benefits.

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